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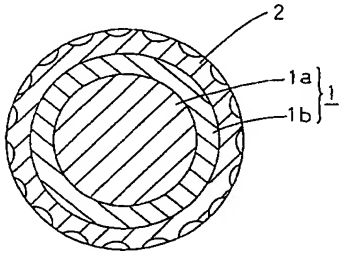
(54) Golf ball.

(57) A golf ball comprises a core 1 composed of a centre 1a and an outer shell 1b, and a cover 2 covering the core 1, wherein the specific gravity of the centre 1a is in the range of from 0.2 to 1. The golf ball has an excellent flight distance and satisfies the other requirements of golf balls.

Fig. 1



EP 0 600 721 A1

The present invention relates to a golf ball having a three layer construction which is obtained by covering a core composed of a centre and an outer shell with a cover.

Conventionally, the main type of three-layered golf ball has been the so-called thread wound golf ball which is obtained by winding rubber thread around a centre filled with a solid or liquid and then covering the rubber-thread wound centre with a cover mainly made of natural or synthetic resin (for instance, Japanese Kokai Publication Sho 60(1985)-168471).

However, the thread wound golf balls are inferior to two-piece solid golf balls with a two-layer construction obtained by covering a solid core with a cover mainly made of an ionomer resin, in respect of flight distance. The two-piece solid golf ball, however, does not fully satisfy all of the requirements of golf balls.

Thus the objective of the present invention is to solve the aforesaid problems and provide golf balls with an excellent flight distance and other satisfactory properties.

The present invention achieves the aforesaid objective constituting the golf ball in such a way that the core is made into a two-layer construction namely, a centre and an outer shell, the specific gravity of the centre being in the range of from 0.2 to 1 and the core of two layered construction being covered with a cover mainly made of an ionomer resin.

In the present invention, the central part of the golf ball is made lighter by reducing the specific gravity of the centre to 0.2 to 1 and thereby increasing the moment of inertia of the golf ball so that the ball spin is less and the ball flight angle is higher than that of the conventional two-piece golf balls.

The construction of the golf ball of the present invention is described with reference to Figure 1 which is a sectional view which shows schematically an example of the golf ball of the present invention.

In the drawing, 1 is the core, which comprises a centre 1a and an outer shell 1b wherein the specific gravity of the centre 1a is in the range of from 0.2 to 1. The outer cover 2 covers the core 1 of two-layer construction, the cover being mainly made of an ionomer resin.

The centre may comprise a vulcanized rubber containing a light weight filler, a resin containing a light weight filler, foamed rubber, foamed resin, etc.

For example, the rubber composition used for obtaining the vulcanized rubber for construction of the centre preferably contains a butadiene rubber as the base rubber and a metal salt of an α,β-ethylenically unsaturated carboxylic acid as the vulcanization agent. Preferred metal salts of α,β-ethylenically unsaturated carboxylic acids are zinc acrylate or zinc methacrylate. The vulcanization agent may be formed when mixing the rubber composition obtained by reacting an α,β-ethylenically unsaturated carboxylic acid with a metal oxide (e.g. zinc oxide) during kneading for the preparation of the rubber composition.

Another rubber, such as natural rubber, an isoprene rubber, a styrene-butadiene rubber etc., may be mixed with the butadiene rubber.

Since the specific gravity of the centre must be from 0.2 to 1, it is necessary to use a light weight filler and for such a light weight filler, it is preferred to use hollow plastic particles or hollow glass particles.

The vulcanization initiator may be an organic peroxide and the preferred example thereof is dicumyl peroxide. Alternatively, the vulcanization may be effected by ordinary sulfur vulcanization using an unsaturated ester monomer.

The preferred example of the rubber composition to be used for the preparation of the centre comprises 100 wt parts of a rubber component and 2 to 15 wt parts of the metal salt of an α,β-ethylenically unsaturated carboxylic acid (or alternatively, a combination of 2 to 15 wt parts of an α,β-ethylenically unsaturated carboxylic acid and 2 to 15 wt parts of metal oxide), up to 200 wt parts of the light weight filler and 0.5 to 5 wt parts of the vulcanization initiator.

When the centre is made from a foamed resin, the resin used may be a thermoplastic resin such as an ionomer resin, polyethylene, polystyrene or a thermo-setting resin such as a phenolic resin.

In the present invention, the reason why the specific gravity of the centre is required to be from 0.2 to 1 is because when the specific gravity of the centre is less than 0.2, molding of the centre is difficult, whilst when the specific gravity of the centre is greater than 1, the effect of the higher moment of inertia for improvement of flight distance is less.

The weight of the outer shell is preferably determined in relation to the weight of the centre, so that the weight of the entire core combining the centre and the outer shell is within the range of from 32.0 to 39.0 g.

The outer shell is composed from vulcanized rubber. The rubber composition for the manufacture of the outer shell contains butadiene rubber as the base rubber, similar to the centre. The rubber composition containing this base rubber, vulcanization agent, vulcanization initiator etc. may be the same as that used for the centre.

However, in order to adjust the weight of the entire core, it is preferred to use a filler with a high specific gravity for the outer shell and such a filler may be, for example, tungsten, tungsten carbide, barium sulfate or zinc oxide, but it is not limited thereto. It is also possible to use a vulcanization agent different from that used

for the centre.

The preferred example of the compounding ratio of the composition for the manufacture of the outer shell comprises 10 wt parts of a rubber component, 10 to 50 wt parts of the metallic salt of an α,β-ethylenically unsaturated carboxylic acid (or alternatively a combination of 10 to 50 wt parts of an α,β-ethylenically unsaturated carboxylic acid and 10 to 50 wt parts of metal oxide), 3 to 200 wt parts of the filler with a high specific gravity and 0.5 to 1.5 wt parts of the vulcanization initiator.

Since it is necessary to adjust the specific weight of the outer shell in relation to the specific gravity of the centre so that the weight of the entire core is within the specific range, the range of variation of the compounding amount of the filler is large as aforesaid.

The diameter of the centre and diameter of the outer shell (outer diameter of the core) etc. are not specifically restricted, but the diameter of the centre is preferred to be about 10 to 38 mm and the diameter of the outer shell is preferred to be around 37 to 40 mm although it depends on the diameter of the centre.

When the centre is composed of the vulcanized rubber, the rubber composition for the manufacture of the centre is usually placed in a metal mould and press moulded under vulcanization while the vulcanization condition during press-moulding is preferably 145 to 180°C and 15 to 50 minutes. However, the temperature of the vulcanization moulding is not necessarily constant and the temperature may be changed in more than two stages.

On the other hand when the centre is composed of the foamed resin, moulding is conducted by injection-moulding or press-moulding. In the case of injection-moulding, it is preferred that the heating temperature in the metal mould is 240 to 250°C, the heating time is from 2 to 10 min. and the cooling time is from 1 to 5 min. In the case of press-moulding, the preferred temperature is 240 to 250°C, the heating time in the metal mould is from 5 to 30 min. and the cooling time is from 1 to 10 min.

The outer shell is usually moulded by applying a sheet of the desired thickness of the rubber composition used for the preparation of the outer shell over the surface of the moulded centre and press-moulding it.

However, the method is not restricted thereto and a method may be employed such that two half shells are moulded, for example by injection moulding, and the two half shells are joined together.

In the moulding of the aforesaid centre or outer shell, the vulcanization is not necessarily required to be a crosslinking through sulfur and therefore it may be more appropriate to express it as a "crosslinking" but in this specification, following the customary practice, it is expressed as a vulcanization.

The cover is formed by covering the core with cover material mainly composed of an ionomer resin and, as required, with an appropriate amount of an inorganic oxide such as titanium dioxide (TiO_2) on the core having a two layer construction. It is preferred that the specific gravity of the cover is within the range of from 0.9 to 2.0.

To form the covering, an injection moulding method is usually employed but it is not limited thereto. The ionomer resin may be mixed with an appropriate amount of another resin (e.g. polyethylene, polyamide etc.), as necessary.

The thickness of the cover is not specifically restricted but it is usually from 1.0 to 2.7 mm. At the time of moulding the cover, dimples may be formed as required and after moulding or during the moulding of the cover, paint or marking is applied as necessary.

Examples

The present invention is described more fully with reference to the following examples. However, the present invention is not limited to these examples.

Examples 1 and 2 and Comparative Example 1

Ingredients with the compounding ratio as shown in Table 1 were kneaded to prepare a rubber composition for the preparation of the centre of Example 1 and Comparative Example 1. The kneaded mixture was made into a sheet, placed in a metal mould and moulded under vulcanization at 150°C for 30 min. for Example 1 and at 155°C for 25 min. for Comparative Example 1, to prepare the centre having a diameter of 31 mm.

For Example 2, the mixture of ionomer resin and foaming agent with the composition as shown in Table 1 was injection-moulded for 10 min. at 240°C to prepare a centre having a diameter of 31 mm. Table 1 shows the specific gravity of the centre obtained in Examples 1 and 2 and Comparative Example 1. The compounding amounts of the materials of Table 1 are indicated as weight parts.

Table 1

Centre	Example 1	Example 2	Comp Ex 1
Butadiene rubber *1	100	-	100
Zinc Oxide	5	-	18.5
Zinc Acrylate	5	-	23
Hollow Glass Particles *2	70	-	-
Dicumyl Peroxide	2	-	1.4
Ionomer Resin *3	-	100	-
Foaming Agent *4 (master batch)	-	55	-
Moulding Condition (^{o}C min)	150 - 30	240 - 10	155 - 25
Specific Gravity (23^{o}C)	0.79	0.28	1.14
Outer Diameter (mm) (Note)	31	31	31

*1: Butadiene rubber with cis content of more than 90%.

*2: Glass bubbles, S60/10000 (tradename), manufactured by Sumitomo 3M Co.

*3: Himilan No. 1705 (tradename), manufactured by Mitsui DuPont Polychemical Co.

*4: Polystyrene 1 0600HL (tradename), manufactured by Eiwa Kasei Co. Ltd.

Next the rubber composition for the manufacture of the outer shell with the composition as shown in Table 2 was prepared. The compounding amounts of the materials in Table 2 are also as weight parts.

Table 2

Outer Shell			
	Example 1	Example 2	Comp Ex 1
Butadiene rubber	100	100	100
Zinc Oxide	41.4	135	18.5
Zinc Acrylate	38	38	25
Dicumyl Peroxide	1.2	1.2	1.5

The rubber composition for the manufacture of the outer shell was made into a sheet, applied around the centre of Examples 1 and 2 and Comparative Example 1 and the core was made by press-vulcanization under the moulding conditions shown in Table 3.

Table 2 showns the diameter of the core (the same as the diameter of the outer shell), the weight and the surface hardness of the core.

Table 3

Core			
	Example 1	Example 2	Comp Ex 1
Moulding condition (°C min)	150 - 30	150 - 30	150 - 30
Diameter of core (mm)	38.4	38.4	38.4
Weight of core (g)	34.5	34.6	34.6

Subsequently the cover material was prepared by adding and blending 2 wt parts of titanium oxide (TiO_2) into 100 wt parts of ionomer resin (a 50:50 mixture by weight of Himilan 1706 (tradename) and Himilan 1605 (tradename) manufactured by Mitsui DuPont Polychemical Co.) and each core was covered with the cover material by injection moulding to prepare a golf ball having an outer diameter of 42.7 mm.

Table 4 indicates the results of the measurement of weight, compression and flying distance of the obtained golf ball according to USGA method. The flying distance represents the measured values for the case when the ball is hit by a driver at the head speed of 45 m/sec. using a swing robot (it is expressed in Table 4 as (HS 45 m/s by W No. 1)) and for the case when the ball is hit by a No. 5 iron at the head speed of 38 m/sec. using the swing robot (it is expressed in Table 4 as (HS 38 m/s by No. 5)).

Table 4 also showns the results of investigation of the physical properties of the standard two-piece solid golf ball and thread wound golf ball. The aforesaid two-piece golf ball is the ball having a diameter of 42.7 mm obtained by vulcanization moulding of the rubber composition compressing 100 wt parts of butadiene rubber compounded with 30 wt parts of zinc acrylate, 20.5 wt parts of zinc oxide ad 1.5 wt parts of dicumyl peroxide and covering the thus obtained solid core with the same ionomer resin-based cover as aforesaid to make the outer diameter of the ball 42.7 mm, wherein the diameter of the solid core is 38.4 mm and the weight is 34.7 g.

A thread wound golf ball is the ball obtained by covering the core of thread wound construction with an ionomer resin-based cover to make the diameter of the ball 42.7 mm, wherein the diameter of the aforesaid thread wound core is 38.8 mm and the weight is 35.3 mm.

Table 4

	Physical properties of golf ball			
	Weight (g)	Compression	Flight distance (yard) (W#1) HS 45 m/s	Flight distance (yard) 1#5 HS 38 m/s
Example 1	45.4	87	234	168
Example 2	45.4	108	236	169
Comp. Ex.1	45.6	108	224	163
Two-piece solid golf ball	45.5	104	229	166
Thread would golf ball	45.3	92	226	163

The golf ball of Comparative Example 1 is the golf ball with a 3-layered construction wherein the specific gravity of the centre is above 1 and is similar to the specific gravity of the outer shell. As shown in Table 4, the golf balls of Examples 1 and 2 have a longer flight distance than the golf ball of Comp. Example 1 and the flight distance was longer than those of the two-piece flight solid golf balls or thread wound golf balls. In particular, the ball of Example 1 had a longer flight distance, although the compression was low being 87 (which means it is soft and the impact resistance at the time of hitting is less).

As described above, the present invention provides the golf ball with a good flying distance by using the core of two layer construction, namely, a centre and an outer shell, setting the specific gravity of the centre at 0.2 to 1 and covering the core with a cover made mainly of Ionomer.

Claims

1. A golf ball comprising a core (1) composed of a centre (Ia) and an outer shell (Ib), and a cover (2) covering the core (1), whrein the specific gravity of the centre (Ia) Is in the range of from 0.2 to 1.

2. A golf ball as claimed in claim 1 wherein the centre (Ia) is prepared from a rubber composition which comprises a rubber, a metal salt of an α,β-ethylenically unsaturated carboxylic acid, a light weight filler and a vulcanization initiator.

3. A golf ball as claimed in claim 2 wherein the rubber is butadiene rubber.

4. A golf ball as claimed in claim 2 or claim 3 wherein the light weight filler comprises hollow resin particles or hollow glass particles.

5. A golf ball as claimed in any one of the preceding claims whrein the centre Is made of foamed resin.

6. A golf ball as claimed in any one of the preceding claims wherein the outer shell (Ib) is prepared from a rubber composition which comprises a rubber, a metal salt of an α,β-ethylenically unsaturated carboxylic acid, a heavy weight filler and a vulcanizatIon initiator.

7. A golf ball as claimed in claim 6 wherein the rubber is butadiene rubber.

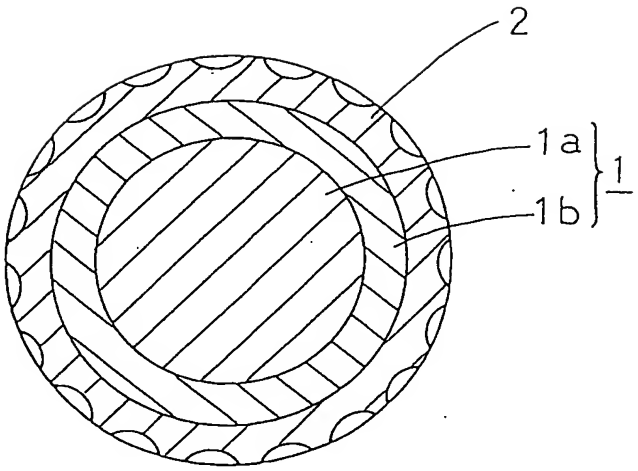
8. A golf ball as claimed in claim 6 or claim 7 wherein the heavy weight filler is tungsten, tungsten carbide, barium sulfate or zinc oxide.

9. A golf ball as claimed in any one of the preceding claims wherein the core has a weight of 32.0 to 39.0 g.

10. A golf ball as claimed in any one of the preceding claims wherein the cover is made of an ionomer resin.

11. A golf ball as claimed in any one of the preceding claims wherein the cover has a thickness in the range of from 1.0 to 2.7 mm.

Fig. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 9591

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X Y	US-A-5 026 067 (GENTILUOMO) * column 1, line 53 - column 2, line 6 * * column 2, line 47 - line 48 *	1,4,5,10 2,3,6-9, 11	A63B37/02
Y	GB-A-2 245 580 (ILYA CO LTD) * page 7, line 15 - line 29; figures * * page 8, line 1 - line 16; table 1 *	2,3,6-9, 11	
A	GB-A-2 167 309 (SUMITOMO RUBBER INDUSTRIES LTD.) * page 1, line 54 - line 58 * * page 2, line 48 - line 55; table 1 *	1,8-11	
A	US-A-4 085 937 (SCHENK) * abstract *	1,4	
A	EP-A-0 154 735 (MACGREGOR GOLF COMPANY) * claims 1,2,4,5 *	1,4,5	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

A63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 March 1994	Jones, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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